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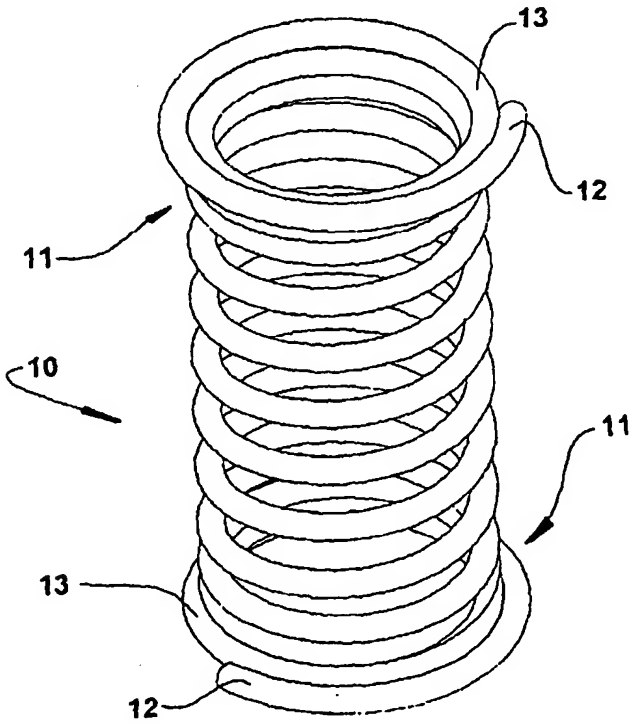
(54) Title: SUSPENSION SYSTEM FOR A RECIPROCATING HERMETIC COMPRESSOR



(57) Abstract: A suspension system for a reciprocating hermetic compressor of the type comprising a motor-pump unit (1) mounted inside a shell (2), by an assembly of cylindrical helical dampening springs (10), each presenting a pair of fixation end regions (11), each dampening spring (10) presenting at least one of its fixation end regions (11) having at least one end coil (12) with a diameter superior to that of an immediately adjacent internal coil (13) against which it is seated, said diameter being calculated so that at least said end coil (12) determines a plane substantially orthogonal to the longitudinal axis of the dampening spring (10).

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"SUSPENSION SYSTEM FOR A RECIPROCATING HERMETIC COMPRESSOR"

Field of the Invention

The present invention refers to a suspension system to be used in a reciprocating hermetic compressor, particularly with a vertical shaft, in which the fixation of the motor-pump assembly inside the shell is generally provided by springs.

Background of the Invention

Reciprocating hermetic compressors with a vertical shaft are conventionally provided with a suspension system by springs, in order to insulate vibrations of the motor-pump unit in relation to the shell of the compressor. The vibrations generated during normal operation are produced by the oscillation of the mass of the parts of the mechanical motor-pump unit of said reciprocating compressors, such as the piston, the crankshaft, the connecting rod, etc.

The suspension systems of the motor-pump unit in a reciprocating hermetic compressor can be divided in two groups: dampening by using suspension springs and dampening by using compression springs.

In the constructive arrangement using suspension springs, the motor-pump unit is affixed to the shell of the compressor by metallic suspension springs operating in a tensioned condition.

In the constructive arrangement using compression springs, the latter are mounted to the internal lower portion of the shell of the hermetic compressor, under a supporting point of the motor-pump unit, such as schematically illustrated in Figure 1 of the enclosed drawings. In this prior art arrangement, there is a considerable attenuation of the vibrations.

The springs normally used for the function of dampening the vibrations in hermetic compressors are of the cylindrical helical type, due to its simple manufacture, material availability and compliance to

the reliability requirements of the project. The points for anchoring the springs to the mechanical unit and to the shell present several conceptions for the type of dampening by using compression springs.

A solution for anchoring the compression springs to the shell and/or to the motor-pump unit of the hermetic compressors is by using pins, which are stamped or machined, associated to these two elements and conceived so that the springs are positioned through the internal diameter thereof with the external surface of the pins. Springs and pins may be dimensioned in order to obtain a positioning with different degrees of mechanical interference (total, partial or null) between the several elements.

Normally, the limitations of the lateral and vertical movements of the mechanical system inside the shell are obtained by the same supports used for positioning the springs. These limitations are very important to avoid impacts between the parts of the compressor and the generation of noise during normal operation. A variation of said solution is the provision of pins made of plastic material or resin. A derivation of this solution is the provision of notches or recesses in the supports of the springs, for fitting or locking the latter (Figures 1- 3).

Another solution for determining the interface between the shell and the motor-pump unit and the compression springs is the provision of cup shaped supports (Figure 2), which support the springs through the external diameter thereof. Also, in this case, springs and pins may be dimensioned in order to obtain a positioning with different grades of mechanical interference (total, partial or null) between the several components.

Using the type of construction in which the dampening system employs compression springs presents the disadvantage that the ends of the cylindrical helical

springs require to be planed for assuring leveling and correct positioning of the connecting rod-crankshaft mechanical system inside the shell of the compressor.

As a function of the state of the art regarding the manufacture of cylindrical helical springs, planing the ends represents a significant increase in the manufacturing cost. In addition, planing is normally obtained by surface grinding the ends, generating sharp barbs, which also make the mounting difficult.

The construction systems, in which the ends of the compression springs need not be planed, usually employ longer supports for the springs. These longer supports, besides increasing the cost, limit the degree of attenuation of the vibrations, which is the main function of the dampening system. Moreover, longer supports require a larger space, leading to a final product with larger dimensions.

The supporting systems in which are provided notches or recesses for fitting or locking the springs, such as that described in U.S. 6,004,113, have the disadvantage that the assembly of said springs usually requires previous orientation of the components, resulting in a more complex and expensive mounting process (Figure 3).

Disclosure of the Invention

It is a generic object of the present invention to provide a suspension system for a reciprocating hermetic compressor with a vertical shaft, which allows obtaining a considerable attenuation in the transmission of operation and movement vibratory energy from the motor-pump unit to the shell of the compressor, by means of a construction of simple execution and mounting, which does not require planing the ends of the springs of said suspension system.

A further object of the present invention is to reduce the noise resulting from the operation of the motor-compressor unit.

These objects are attained by a suspension system for a reciprocating hermetic compressor of the type comprising: a hermetic shell; a motor-pump unit mounted inside the shell by a suspension system comprising an assembly of cylindrical helical dampening springs, each presenting a pair of fixation end regions, one of the latter being seated on the shell and the other mounted to the motor-pump unit, each dampening spring presenting at least one of its fixation end regions having at least one end coil with a diameter superior to that of an immediately adjacent coil against which it is seated, said diameter being calculated so that at least said end coil determines a plane substantially orthogonal to the longitudinal axis of the spring.

Brief Description of the Drawings

The invention will be described below, with reference to the attached drawings, in which:

Figure 1 illustrates, schematically, a longitudinal sectional view of part of a motor-pump unit mounted inside a compressor shell by a suspension system with dampening springs constructed according to the prior art;

Figure 2 shows a similar view to that of Figure 1, illustrating a form for lodging the spring, according to the prior art considered herein;

Figure 3 illustrates a similar view to that of Figure 1, according to another prior art construction for the dampening spring;

Figure 4 illustrates a perspective view of a dampening spring constructed according to the present invention;

Figure 5 illustrates, schematically, a longitudinal sectional view of the dampening spring as shown in Figure 4;

Figure 6 illustrates, schematically, a top plan view of the dampening spring of Figure 4; and

Figure 7 illustrates, schematically, a similar view to

that of Figure 1 of the dampening spring of the present invention.

Description of the Illustrated Embodiment

The present invention will be described in relation to a hermetic compressor of the type with a vertical shaft and which comprises, as illustrated in Figures 1- 3, a motor-pump unit 1, which is affixed inside a hermetic shell 2, by a suspension system including an assembly of dampening springs 10, particularly compression springs of the metallic, cylindrical helical type, having a first end to be seated on a support portion 4 of the shell 2, and a second end for supporting the motor-pump unit 1.

This suspension system, as illustrated in Figures 1-3, has the deficiencies previously discussed.

According to the present invention and as illustrated in Figures 4-7, the suspension system of the motor-pump unit 1 inside the shell 2 of a hermetic compressor of refrigeration comprises an assembly of dampening springs 10, for example compression springs, each dampening spring 10 presenting a pair of fixation end regions 11, one of them being seated on the shell 2 and the other mounted to the motor-pump unit 1, supporting the latter, each dampening spring 10 presenting at least one of its fixation end regions 11, for example both of them, having at least one end coil 12 with a diameter superior to that of an immediately adjacent internal coil 13 against which it is seated, said diameter being calculated so that at least said end coil 12 determines a supporting plane, substantially orthogonal to the longitudinal axis of the dampening spring.

In a way of carrying out the present invention, at least one of the coils of a respective fixation end region 11 presents a diameter that exceeds that of the internal coil 13, which is immediately adjacent and at least partially coplanar, by a value corresponding to

the diameter of the wire that forms the coils of the dampening spring 10, in order to define for the dampening spring 10 a "L" profile with the respective fixation end region 11.

In the embodiment of the present invention illustrated in Figures 4-7, at least the end coil 12 of a respective fixation end region 11 presents a diameter that exceeds that of the immediately adjacent internal coil 13, by a value lower than that corresponding to the diameter of the wire that forms said coils, defining a substantially conical shape to the dampening spring 10 with the respective fixation end region 11.

In another embodiment of the present invention, part of the coils of a respective end region presents a diameter that is equal to an immediately adjacent coil and larger than the coils away from the fixation end regions 11.

With this suspension system, the ends of the dampening springs are already flat, obtained with no need of planing. The plane, which is generated by winding the last coil in a determining pitch and diameter, determines to each dampening spring 10 a supporting plane, which is required to assure leveling of the motor-pump unit inside the shell 2, mainly during the compressor operation. Such construction may be easily obtained by a spring winding process, varying the pitch and diameter of at least the end coil 12 of each fixation end region of said dampening spring 10.

The solution of the present invention presents, in relation to the conventional constructions, the advantage of using conventional known processes for producing springs with no need of complementary planing operations to form the supporting plane, evidently reducing the manufacturing cost of said springs and without requiring orientation for mounting these dampening springs, as it occurs with those

springs presently used, where the supporting plane is obtained by planing the end coil 12, or by providing a support which compensates for not planing said end coil 12.

Moreover, the concept presented herein can also be used for the suspension springs, provided that the end coils 12 thereof are formed in order to generate an anchoring plane.

CLAIMS

1. A suspension system for a reciprocating hermetic compressor of the type comprising: a shell (2), a motor-pump unit (1), which is mounted inside the shell (2) by a suspension system comprising an assembly of cylindrical helical dampening springs (10), each presenting a pair of fixation end regions (11), one of the latter being seated on the shell (2) and the other mounted to the motor-pump unit (1), characterized in that each dampening spring (10) presents at least one of its end regions (11) having at least one end coil (12) with a diameter superior to that of an immediately adjacent internal coil (13) against which it is seated, said diameter being calculated so that at least said end coil (12) determines a plane substantially orthogonal to the longitudinal axis of the dampening spring (10).

2. System, according to claim 1, characterized in that at least one of the coils of a respective fixation end region (11) presents a diameter that exceeds that of the end coil (13) that is immediately adjacent and at least partially coplanar, by a value corresponding to the diameter of the wire that forms said coils.

3. System, according to claim 2, characterized in that at least the end coil (12) of a respective fixation end region (11) presents a diameter that exceeds that of the immediately adjacent internal coil (13), by a value lower than that corresponding to the diameter of the wire that forms said coils.

4. System, according to claim 1, characterized in that part of the coils of a respective fixation end region (11) presents a diameter that is equal to that of an immediately adjacent coil and larger than that of the coils away from the fixation end regions (11).

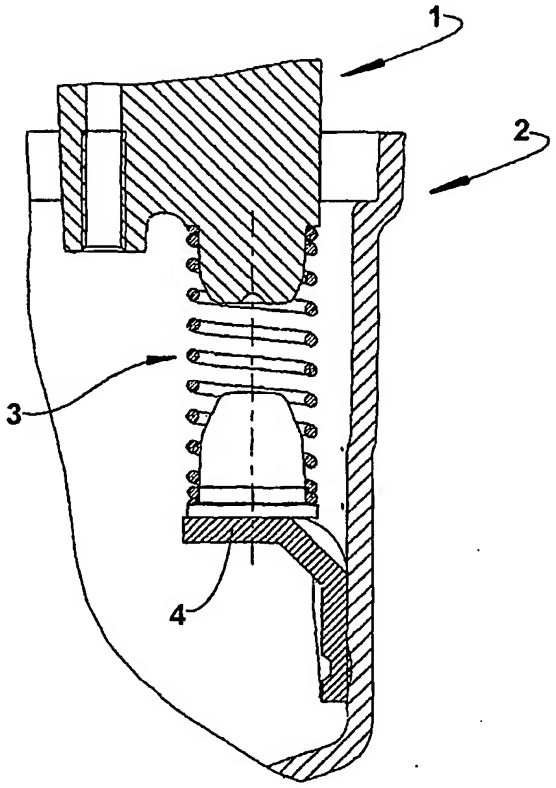

FIG.1
PRIOR ART

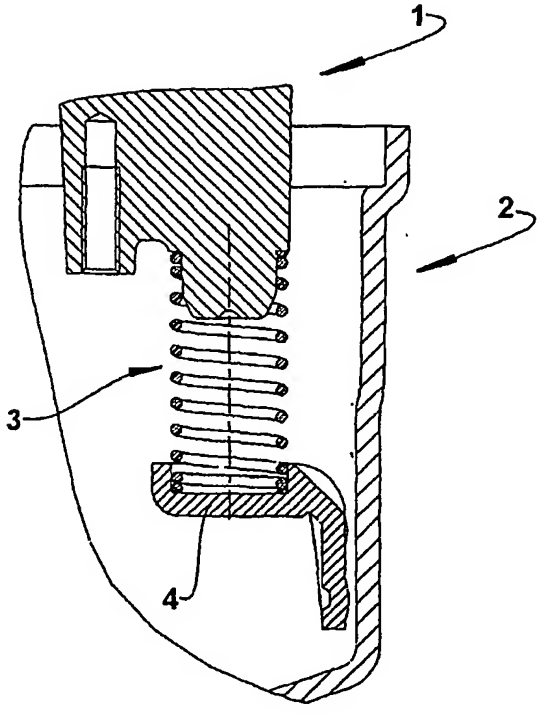

FIG.2
PRIOR ART

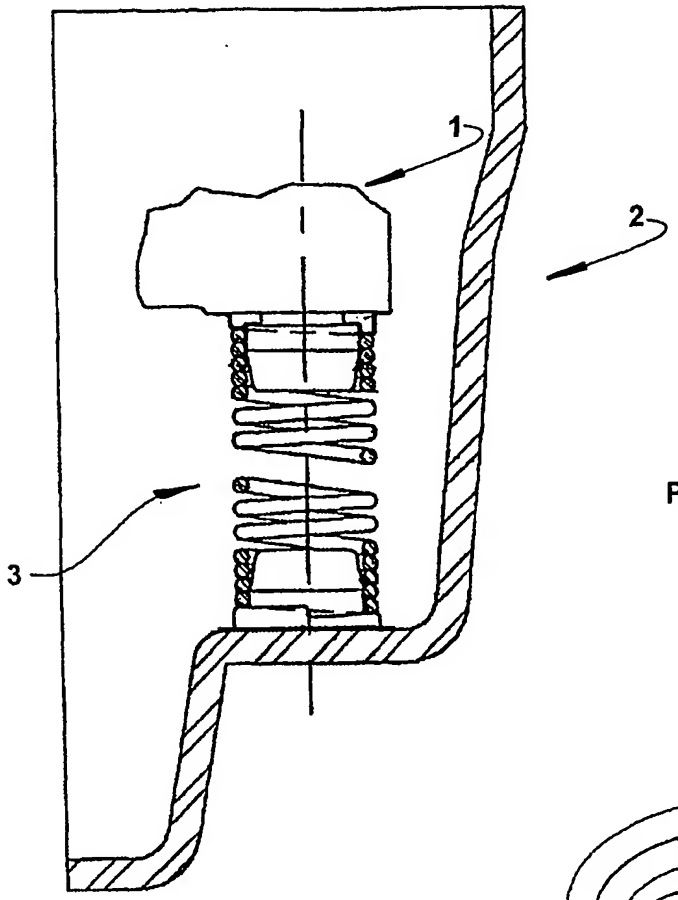

FIG.3
PRIOR ART

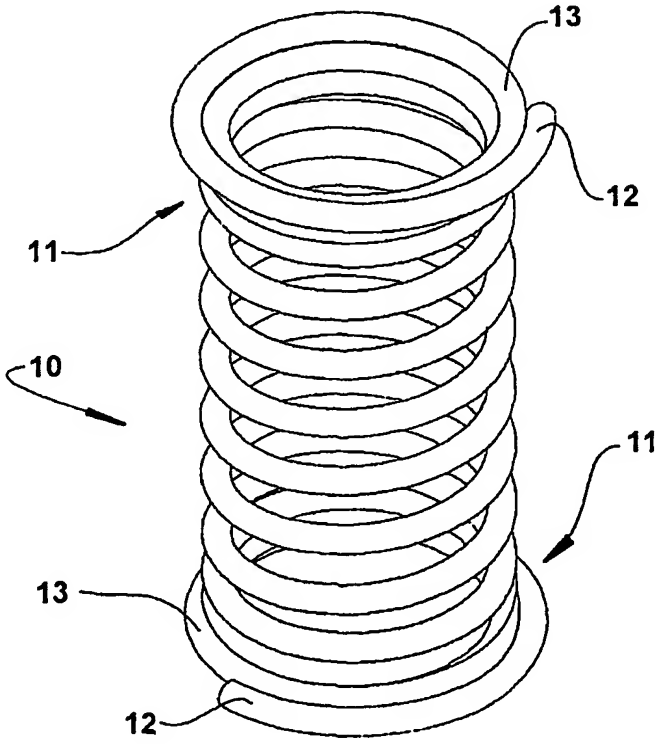

FIG.4

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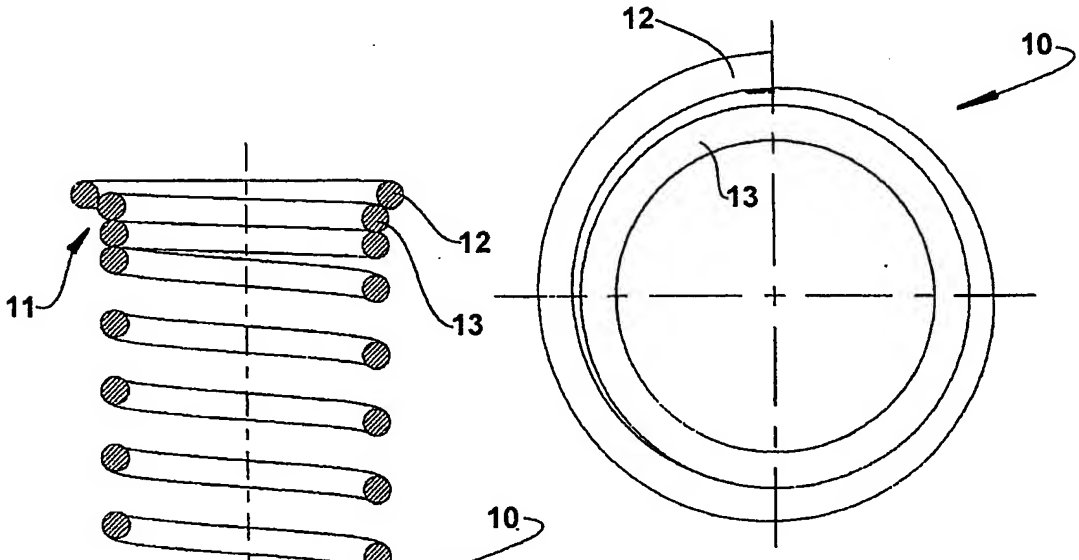

FIG.6

FIG.5

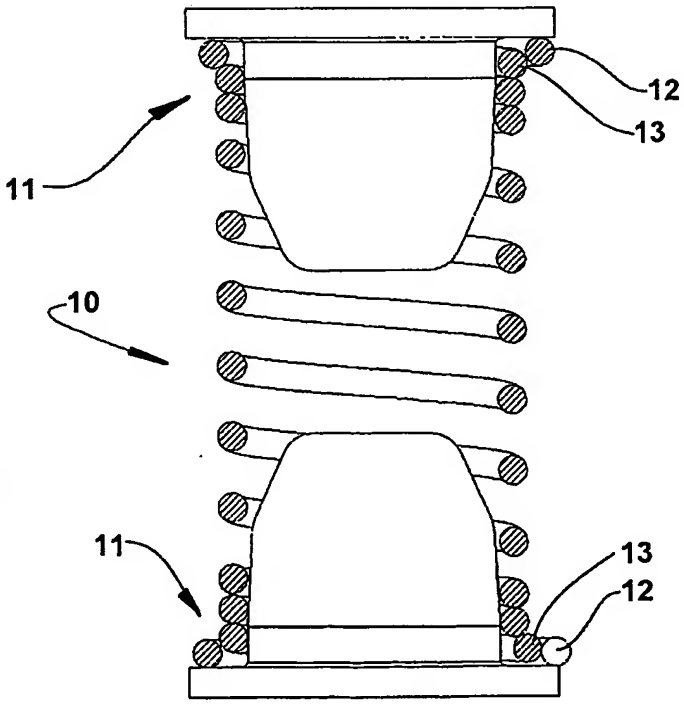

FIG.7